PRELIMINARY

INSTRUCTION MANUAL

REGULATED POWER SUPPLIES

MODEL LM F4-OVY-2361

MP MASTER
MA28779

LAMBDA

LAMBDA ELECTRONICS CORP.-MELVILLE, L. I., N. Y.

MODEL LM F4-OVY-2361

INSTRUCTION MANUAL

FOR

REGULATED POWER SUPPLIES

MODEL LM

F PACKAGE

THIS MANUAL APPLIES TO UNITS

BEARING SERIAL NO. PREFIXES A, B

This manual provides instructions intended for the operation of Lambda power supplies, and is not to be reproduced without the written consent of Lambda Electronics Corp.

LAMBDA ELECTRONICS CORP. MELVILLE, L.I., N.Y.

MAIN PLANT TELEPHONE: 516 MYrtle 4-4200

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ADDENDA

MODEL LM F4-OVY-2361

The paragraphs of this instruction manual apply in general to the above model.

This modified unit differs from a standard unit in the following way:

The front panel will contain two test jacks for monitoring the DC output voltage.

SPECIFICATIONS AND FEATURES

The following specifications apply for all Lambda F package LM power supplies. Specification exceptions noted here relate to models incorporating model option "Y" and/or "T". Performance specifications do not change for models with suffix "R", e.g., LM-F4-R unless the models also include model options "Y" and/or "T" e.g., LM-F4-YR; for these models the appropriate specification exceptions also apply.

NOTE: Specifications in italics apply only for Lambda models with a "Y" suffix, e.g., LM-F4-Y. AC INPUT specification with an asterisk*, applies only for Lambda models with a "T" suffix, e.g., LM-F4-YT.

DC OUTPUT--Voltage regulated for line and load

Voltage Range.... For voltage range see table I of pertinent model group.

Multi-Current Ratings.... Current ratings specified for each maximum ambient temperature apply over entire output voltage range, with input frequency 55-65 cps. For input frequencies 45-55 at 105-132 VAC or 200-250 VAC, derate maximum current ratings 10% at all ambient temperatures.

For input frequencies 360-440 cps, consult factory for current ratings.

For maximum current ratings at each ambient temperature see table I of pertinent model group.

REGULATED VOLTAGE OUTPUT

Regulation (line)... Less than 0.05 percent plus 4.0 millivolts for input variations from 105-132 or 132-105 volts AC

... Less than 0.01 percent plus 1.0 millivolt for input variations from 105-132 or 132-105 volts AC

Regulation (load)... Less than 0.03 percent plus 3.0 millivolts for load variations from 0 to full load or full load to 0

... Less than 0.02 percent plus 2.0 millivolts for load variations from 0 to full load or full load to 0

Remote Programming

External Resistor... Nominal 200 ohms/volt output

Programming Voltage... One-to-one voltage change

Ripple... One millivolt rms; 3 millivolts peak-to-peak with 45-65 cps input

... One millivolt rms; 15 millivolts peak-to-peak with 360-440 cps input

...0.5 millivolt rms; 3 millivolts peak-to-peak with 45-65 cps input

Temperature Coefficient... Change in output voltage less than 0.03%/°C

... Change in output voltage less than 0.01%/°C

AC INPUT--105-132 volts AC at 45-440 cps; 900 watts+

\+ With output loaded to full 40°C rating and input voltage 132 volts at 55-65 cps.

*... 200-250 volts AC at 45-440 cps

INPUT FUSE--"SLO-BLO" fuse F1 protects the AC input circuit. Overload of the supply does not cause fuse failure.

OVERLOAD PROTECTION

Thermal.... Thermostat resets automatically when overtemperature condition is eliminated

Electrical... Within rated voltage range, an automatic electronic current-limiting circuit limits output current to approximately 110 percent of 40°C rated current for protection of load and power supply; for overloads approaching short circuit, both voltage and current decrease until at short circuit, current is 30 percent or less of rated current.

OVERSHOOT--No overshoot of output voltage under conditions of power turn-on, power turn-off, or power failure.

INPUT AND OUTPUT CONNECTIONS--Heavy duty terminal block on rear of chassis

OPERATING AMBIENT TEMPERATURE RANGE AND DUTY CYCLE-- Continuous duty from 0°C to 71°C ambient with corresponding load current ratings for all modes of operation.

STORAGE TEMPERATURE-- -55°C to +85°C

METERS--Voltmeter and ammeter monitor the voltage and load output current respectively on metered (M) models.

CONTROLS

DC output control... VOLT ADJ. control on front panel of all units permits adjustment of DC output voltage.

Overvoltage Control... On units with overvoltage circuit, OV ADJ control permits setting of the overvoltage protection point.

Power... Panel-mounted magnetic circuit breaker on "OV" suffix models or power-on switch on all other models and indicator light. The circuit breaker or switch controls application of input power to the supply. Overvoltage condition causes the breaker to trip. When the breaker or switch is in the ON position the red ON indicator lamp glows.

REMOTE SENSING--Provision is made for remote sensing to eliminate effect of power output lead resistance on DC regulation.

PHYSICAL DATA

Size.....3-15/32" H x 19" W x 16-1/2" D

Weight.....60 lbs. net; 90 lbs. shipping wt.

Panel Finish..... Brushed aluminum clear anodized panels with grey inlay (Standard); special finishes available to customer's specifications at moderate surcharge.

MOUNTING--Standard 19" rack mounting.

MODEL OPTIONS

Suffix "T" Input Option... Standard LM power supplies are available for operation with 200-250 volt, 45-440 cps input.

Suffix "Y" High Performance Option... All Lambda LM power supplies are available with high performance specifications. See italicized entries under SPECIFICATIONS AND FEATURES.

Suffix "R" Fungus Proofing Option... Standard LM power supplies can be obtained with fungus proofing treatment with MIL V 173 varnish for all fungi nutrient components.

Suffix "M" Meter Option... All Lambda LM power supplies are available with voltmeter and ammeter.

Suffix "OV" Overvoltage Protection Option... All LM-F power supplies are available with a built-in overvoltage protection circuit which prevents damage to the load that can be caused by excessive power supply output voltage.

THEORY OF OPERATION

GENERAL

The Lambda power supply consists of an AC input circuit and transformer; a bias supply consisting of an auxiliary rectifier, filter, and a zener diode regulator; a drive supply consisting of a rectifier and filter; and a main regulator circuit consisting of the main rectifier and filter, a series regulator, emitter follower drivers, an error amplifier, a current limit amplifier, an output voltage sensing circuit and an output current sensing resistor. In addition a fault protector circuit is provided.

The circuit arrangement is shown in block diagram form in figure 7. The circuitry is discussed with reference to the block diagram and the schematic diagram.

FUNCTIONAL DESCRIPTION

Single phase input power is applied to transformer T1 through the input circuit containing thermostat S1, which protects the supply against overheating.

The main rectifier, a full-wave rectifier, provides the power which is filtered and then regulated via a series regulator and delivered to the output. Bias supply, half-wave, auxiliary rectifier CR7, provides voltage filtered by capacitor C7 and regulated by zener diode CR6 for current limit amplifier Q3, fault protector Q7 and error amplifier Q1, Q2. Zener diode CR1 and resistor R5, across the bias supply, provide a regulated temperature compensated reference voltage. Resistor R4 compensates for input voltage variations. The drive supply, a full-wave rectifier, provides voltage for drivers Q5, Q6.

Operation of the voltage regulator circuit is determined by changes in the output voltage. A change in the output voltage is sensed by the sensing divider resistors which compare output voltage with the +S reference voltage. This provides an error voltage at junction of R2 and R3 which is amplified by error amplifier Q1, and Q2 and is current amplified by drivers Q5, Q6. The amplified signal from the drivers controls the voltage across the series regulator transistors, which function as the active regulating element, restoring output voltage to the proper level.

Current limit circuit operation is determined by changes in the load. Current limit amplifier Q3 samples load current through current sensing resistor R25A. When the voltage drop across R25A increases compared with the preset voltage reference determined by R17 and R18, Q3 conducts. Thus, when the output current rating of the unit is exceeded, current limit amplifier Q3 conducts decreasing the current through drivers Q5, Q6, resulting in an increase of voltage across the series regulator and a decrease of the output voltage, effectively limiting the output current to a safe value. The current limit value is determined by the factory setting of current limit potentiometer R17.

When operating conditions approach short circuit, the output voltage decreases. Since the voltage determined by R17 and R18 is proportional to the output voltage, when the output voltage decreases, Q3 is biased into turn-on at lower and lower load currents until output voltage decreases to zero and current decreases to a predetermined low value.

During normal operation of the supply, with no faults occurring, fault protector transistor Q7 is at cutoff and not conducting. When an operation malfunction occurs because of open sense leads or improper series regulator operation, increased current through R39 causes Q7 to be biased on. With Q7 conducting, drive current is diverted from drivers Q5, Q6 and from the series regulator through fault protector Q7, thereby protecting these transistors from damage that can be caused by excessive drive current.

OVERVOLTAGE PROTECTOR CIRCUIT, FUNCTIONAL DESCRIPTION

Divider network OV-R1, OV-R2, OV-R3, OV-R4 and OV-R7 attenuates the power supply output voltage. When the power supply output voltage increases above the overvoltage limit set by OV ADJ control OV-R1, the attenuated voltage of the divider network also increases, biasing transistor OV-Q1 on. OV-Q1, in turn, biases OV-Q2 on through resistor OV-R10. OV-Q2 supplies gate current to OV-SCR-1, turning it on, driving current through the breaker trip coil and into the gate of SCR-71, turning SCR-71 on. This, in turn, causes the voltage at the power supply terminals to drop, protecting the load from excessive supply output voltage. OV-SCR-1 and SCR-71 conduct until the circuit breaker trips, causing power to the power supply to be cut off.

CAUTION

The overvoltage protector will not provide protection against overvoltage conditions caused by storage batteries or other power sources used in conjunction with the Lambda power supply. Whenever additional power sources must be used with the Lambda power supply and overvoltage protector combination, consult the factory for proper installation information.

BASIC MODE OF OPERATION

This power supply operates as a constant voltage source provided the load current does not exceed the rated value at 40°C. For continuous operation, load current must not exceed the rating for each ambient temperature. When load current exceeds 110% of 40°C rating, both voltage and current decrease until voltage reaches zero and the current at short circuit equals 30 percent or less of the rated current.

CONNECTIONS FOR OPERATION

NOTE: Make all connections to the unit before applying AC input power.

Ground Connections. The Lambda power supply can be operated either with negative or positive output terminal grounded. Both positive and negative ground connections are shown in the diagrams for all suggested output connections illustrated in this manual.

Connection Terminals. Make all connections to the supply at the terminal block on the rear of the supply. Apply input power to terminals 1 and 2; always connect the ungrounded (hot) lead to terminal 1.

The supply positive terminal is brought out to terminal 6; the negative terminal to terminal 4.

NOTE: When shipped from the factory, the supply is ready for use as a local-sensing constant voltage source. Jumpers are connected at the factory as shown in figure 3. Take care to remove the appropriate jumpers for load requirements that need different supply-load connections. Refer to the appropriate connection diagram.

Supply-Load Connections. The regulation of the supply at the load may change when connecting leads of practical length are used. To minimize the effect of the output load leads, remote sensing is used. Refer to figure 1 to determine voltage drop for particular cable lengths, wire size and current conditions. Lead lengths must be measured from supply terminals to load terminals as shown in figure 2.

Local-Sensing Connection, See Figure 3.

Remote-Sensing Connection, See Figure 4.

NOTE: Whenever the supply is connected for remote sensing, the total voltage drop across both load leads must not exceed the 5 percent output voltage band width of the power supply.

Programmed Voltage Connection Using External Resistor, See Figure 5. Discrete voltage steps can be programmed with a resistance voltage divider valued at nominal 200 ohms/volt output and a shorting-type switch. For continuous voltage variations, use a variable resistor with the same ohms/volt ratio in place of the voltage divider and shorting-type switch. Use low temperature coefficient resistor(s) to assure most stable operation.

Programmed Voltage Connection Using Programming Voltage, See Figure 6. The power supply voltage output can be programmed with an externally connected programming power supply. The output voltage of the programmed supply will maintain a one-to-one ratio with the voltage of the programming supply.

The programming supply must have a reverse current capability of 6 ma. minimum.

Alternatively, when supplies with less than 6 ma. reverse current capability are used, a resistor capable of drawing 6 ma. at the minimum programming voltage must be connected across the output terminals of the supply. This programming supply must be rated to handle all excess resistor current at the maximum programming voltage.

OPERATION AFTER PROTECTIVE DEVICE SHUTDOWN

Thermostat Shutdown

The thermostat opens the input circuit only when the power supply output current exceeds the current rating specified for the operating ambient temperature causing the temperature of the transistor heat radiator to exceed a maximum safe value. The thermostat will automatically reset when the temperature of the radiator decreases to safe operating value. After eliminating the cause(s) for overheating and allowing time for the power supply to cool to a proper temperature, resume operation of the supply.

Fuse Shutdown

Internal component failure is prevented by a fuse which protects components from damage caused by excessive currents. The fuse will blow when the maximum rated current value for the fuse is exceeded. Fatigue failure of the fuse can occur when mechanical vibrations from the installation combine with thermally induced stresses to weaken the fuse metal. Many fuse failures are caused by a temporary condition and replacing the blown fuse will make the fuse protected circuit operative.

Circuit-Breaker Shutdown (For "OV" Suffix Models Only)

The ON-OFF circuit breaker controls application of input power to all Model LM-F power supplies with built in overvoltage protection. When the power supply output voltage increases above the preset overvoltage limit, the breaker trips, opening the input circuit, causing the ON-OFF indicator to extinguish. After eliminating the cause(s) for overvoltage, resume operation of the supply.

MAINTENANCE

ENERAL

This section describes trouble analysis routine, calibration and test procedures that are useful for ervicing the Lambda power supply. A trouble chart is provided as an aid for the troubleshooter. Refer to ıe section on specifications and features for the minimum performance standards.

ROUBLE ANALYSIS

Whenever trouble occurs, systematically check all fuses, primary power lines, external circuit lements, and external wiring for malfunction before trouble shooting the equipment. Failures and malfunc-ons often can be traced to simple causes such as improper jumpers and supply-load connections or fuse fail-re due to metal fatigue.

Use the electrical schematic diagram and block diagram, figure 7, as an aid to locating trouble auses. The schematic diagram contains various circuit voltages that are averages for normal no load opera-ıon. Measure these voltages using the conditions for measurement specified on the schematic diagram. Use ıeasuring probes carefully to avoid causing short circuits and damaging circuit components.

HECKING TRANSISTORS AND CAPACITORS

Check transistors with an in-circuit transistor checker. If no checker is available, transistors an be checked with an ohmmeter that has a highly limited current capability. Observe proper polarity for NP or NPN to avoid error in measurement. The forward transistor resistance is low but never ZERO; ackward resistance is always higher than the forward resistance.

Do not assume trouble is eliminated when only one part is replaced. This is especially true when ne transistor fails, causing other transistors to fail. Replacing only one transistor and turning power on, efore checking for additional faulty components could damage the replaced component.

When soldering semi-conductor devices, hold the lead being soldered with a pair of pliers or a ommercial heat sink device placed between the component and the solder joint.

NOTE: The leakage resistance obtained from a simple resistance check of a capacitor is not always an indication of a faulty capacitor. In all cases the capacitors are shunted with resistances, some of which have low values. Only a dead short is a true indication of a shorted capacitor.

RINTED CIRCUIT BOARD MAINTENANCE TECHNIQUES

. If foil is intact but not covered with solder it is a good contact. Do not attempt to cover with solder.

. Voltage measurements can be made from either side of the board. Use a needle-point probe to penetrate to the wiring whenever a protective coating is used on the wiring. A brass probe can be soldered to an alligator clip adapted to measuring instrument.

. Always use a heat sink when soldering transistors; a transistor pad with mounting feet is an effective heat sink.

. Broken or damaged printed wiring is usually the result of an imperfection, strain or careless soldering. To repair small breaks, tin a short piece of hook-up wire to bridge the break, and holding the wire in place, flow solder along the length of wire so that it becomes part of the circuitry.

. When unsoldering components from the board never pry or force loose the part; unsolder the component by using the wicking process described below:

(a) Select a 3/16 inch tinned copper braid for use as a wick; if braid is not available, select AWG No. 14 or No. 16 stranded wire with 1/2 inch insulation removed.

(b) Dip the wick in liquid rosin flux.

(c) Place the wick onto the soldered connection and apply soldering iron onto the wick.

(d) When sufficient amount of solder flows onto the wick, freeing the component, simultaneously remove iron and wick.

TROUBLE CHART

The trouble chart is intended as a guide for locating trouble causes, and is used along with the schematic diagram.

The operating conditions assumed for the trouble chart are as follows:

(a) AC power of proper voltage and frequency is present at input terminals.

(b) Either positive or negative terminal is connected to chassis ground.

(c) The power supply is connected for constant voltage with local sensing. See schematic; dotted lines indicate jumpers connected for local sensing operation.

TROUBLE CHART

Sympton	Probable Cause	Remedy
1. No output voltage	No power input, thermostat S1 open	Check power source, S1, line cord and line cord plug; shut off unit, allow to cool and check ambient temperature
	Improper output terminal connection	Refer to appropriate connection diagram, and check for correct connections
	Faulty Q2, CR1, CR6	Check Q2, CR1, CR6 for short and replace as required
2. Unable to adjust output voltage	Damaged VOLTAGE ADJUST control	Check R1 for shorts and/or open: replace as required
	Supply operating as constant current source at current limit value	Remove load, check load value and check for shorts and/or improper supply-load connections; refer to appropriate diagram for correct connections
3. Output voltage too high	Improper output terminal connection	Refer to appropriate connection diagram, and check for correct connections
On OV units, breaker trips and cannot be reset	Improper adjustment of OV ADJ control	Refer to procedure for adjusting OV ADJ control and reset control
	Faulty Q1, R1, Q10-Q27, Q5, Q6 or CR1	Check R1 for open; Q10-Q27, Q5, Q6, Q1 for short; CR1 for open and replace as required
	OV-Q1, OV-Q2, OV-SCR 1 on OV subassembly faulty (least probable fault cause)	Check OV-Q1, OV-Q2, OV-SCR 1 for short and replace as required
4. Output voltage too low	Load resistance improper for unit ratings	Check load resistance value
	Faulty Q2, Q3, R25A, R17	Check Q2, Q3 for short, R25A R17 for open, replace as required

TROUBLE CHART (Cont'd)

Symptom	Probable Cause	Remedy
4. (Cont'd)		
Output voltage too low on units with OV option	Faulty SCR 71 in OV circuit (least probable fault cause)	Remove cathode connection to SCR 71 and reapply power, if output is restored SCR 71 is faulty; replace SCR 71
5. High ripple and unregulated DC output	Load resistance improper for unit ratings	Check load resistance value
6. High ripple	Improper ground	Connect terminal 6 or terminal 4 to ground terminal 5

PERFORMANCE CHECK

Check the ripple and regulation of the power supply using the test connection diagram shown in figure 8. Use suggested test equipment or equivalent to obtain accurate results. Refer to SPECIFICATIONS AND FEATURES for minimum performance standards.

Set the differential meter, DC VTVM (John Fluke Model 825A or equivalent) to the selected power supply operating voltage. Check the power supply load regulation accuracy while switching from the full load to no-load condition. Long load leads should be a twisted pair to minimize AC pick-up.

Use a Variac to vary the line voltage from 105-132 or 132-105 volts AC and check the power supply line regulation accuracy on the VTVM differential meter.

Use a VTVM, Ballantine 320 or equivalent, to measure rms ripple voltage of the power supply DC output. Use oscilloscope to measure peak-to-peak ripple voltage of the power supply DC output.

ADJUSTMENT OF CALIBRATION CONTROL R17

Whenever Q3, R25A or R17 are replaced, and voltage and current indications do not reflect maximum ratings, adjust R17 as follows:

1. Remove AC power input to the supply.
2. Unsolder wiper of R17 from resistor housing and turn to full CW position.
3. Operate power supply for constant voltage with local sensing, connected as shown in figure 3, with no external load.
4. Turn VOLT ADJ control until minimum rated output voltage is obtained.
5. Apply load so that output current is 110% of 40°C rating for the unit.
6. Using an oscilloscope, Tektronix 503 or equivalent, observe output voltage while adjusting R17 in a CCW direction. Adjust R17 until output ripple increases sharply and oscilloscope pattern changes.
7. After adjustment is completed, remove AC power input to the supply and solder wiper of R17 to resistor housing.
8. After soldering, check setting and repeat adjustment procedure if required.

ADJUSTMENT OF OV ADJ CONTROL OV-R1

Adjust the voltage-protection point of overvoltage protector circuit as follows:

1. Turn OV ADJ control on front panel fully clockwise.
2. The recommended voltage-protection point is 115% of normal power supply operating voltage plus one volt. Compute this value for the operation voltage being used.

3. Turn on the power supply, and raise the output voltage to the desired voltage-protection point; monitor the power supply output voltage to assure correct voltage. If the power supply does not have an adequate adjustment range omit steps 4 and 5, and continue with step 6 below.

4. Slowly turn the OV ADJ control counterclockwise until the circuit breaker trips, indicating that the voltage protection point is reached.

5. The voltage-protection point is now set. Reduce power supply output voltage setting before re-applying input power.

6. If the power supply output voltage adjustment range does not extend to the protection-point voltage computed in step 2, proceed as follows:

   a) Turn on power supply and raise output voltage to the normal operating voltage.

   b) Slowly turn the OV ADJ control counterclockwise until the circuit breaker trips.

   c) Refer to chart below, select appropriate volts/turn ratio, and turn OV ADJ control clockwise by the number of turns equivalent to 1 volt plus 15% of the operating voltage.

MODEL	VOLTS/TURN	OVERVOLTAGE ADJUSTMENT RANGE
LM-F3, F3P3, F3P6, F4, F4P5, F5, F6	0.3	3 - 8v
LM-F8, F10, F12, F15	0.8	6 - 20v
LM-F18, F20, F24, F28, F36, F48	2.7	18 - 79v

For Example:

When using power supply LM-F5-OV with output voltage setting of 5 volts, calculate as follows:

$$T = \frac{1 + .15\ (OV)}{V/T}$$

where

T = turns of OV ADJ control

OV = operating voltage of power supply

V/T = volts/turn ratio from chart

$$T = \frac{1 + .15(5)}{0.3} = 5.8$$

Rotate OV ADJ control 5.8 turns in clockwise direction to obtain a voltage setting 1.8 volts above the 5-volt power supply setting, or 6.8 volts.

SERVICE

When additional instructions are required or repair service is desired, contact the nearest office of the Lambda Electronics Corp. where trained personnel and complete facilities are ready to assist you.

Please include the power supply model and serial number together with complete details of the problem. On receipt of this information, Lambda will supply service data or advise shipping for factory repair service.

All repairs not covered by the warranty will be billed at cost and an estimate forwarded for approval before work is started.

PARTS ORDERING

Standard components and special components used in Lambda power supply can be obtained from the factory. In case of emergency, critical spare parts are available through any Lambda office.

The following information must be included when ordering parts:

1. Model number and serial number of power supply and purchase date.
2. Lambda part number.
3. Description of part together with circuit designation.
4. If part is not an electronic part, or is not listed, provide a description, function, and location of the part.

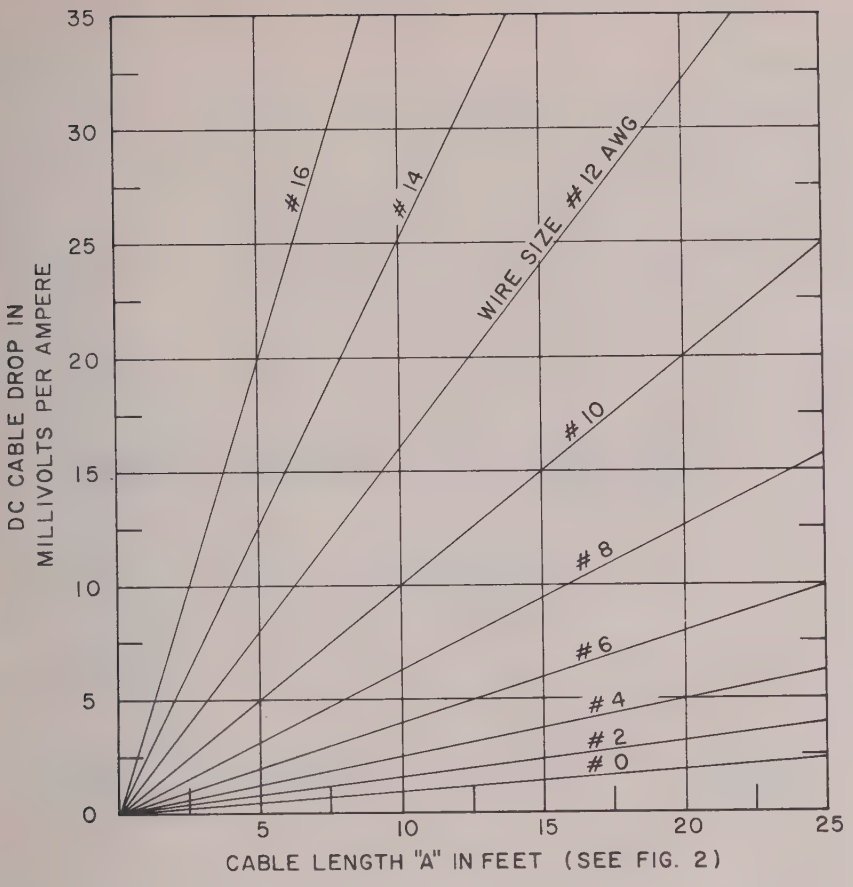


Figure 1. Cable Connection Chart

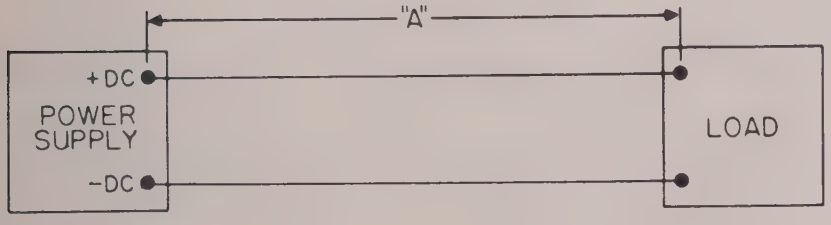
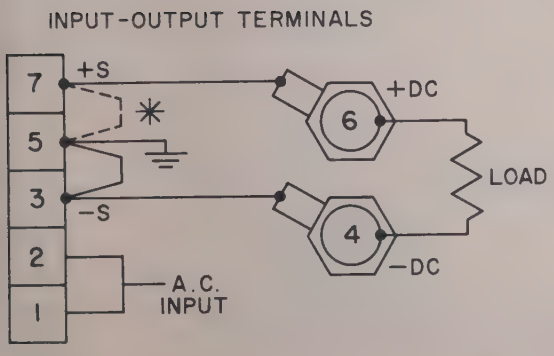
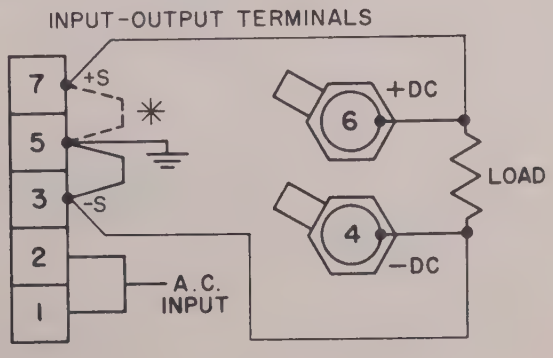


Figure 2. Cable Length "A" in Feet



NOTE:
✳ FOR POSITIVE GROUND, DISCONNECT JUMPER FROM TERMINALS 3 AND 5 AND RECONNECT TO TERMINALS 5 AND 7.

Figure 3. Local Sensing Connections



NOTE:
✳ FOR POSITIVE GROUND, DISCONNECT JUMPER FROM TERMINALS 3 AND 5 AND RECONNECT TO TERMINALS 5 AND 7.

Figure 4. Remote Sensing Connections

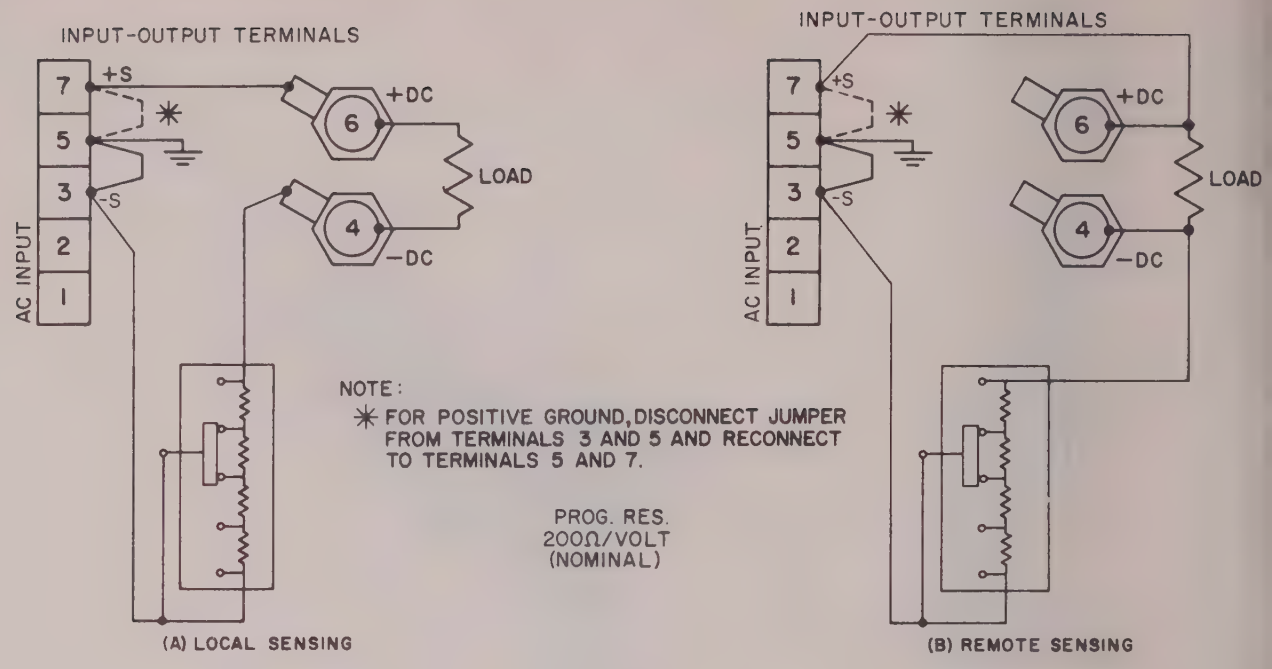


Figure 5. Programmed Voltage With External Resistor

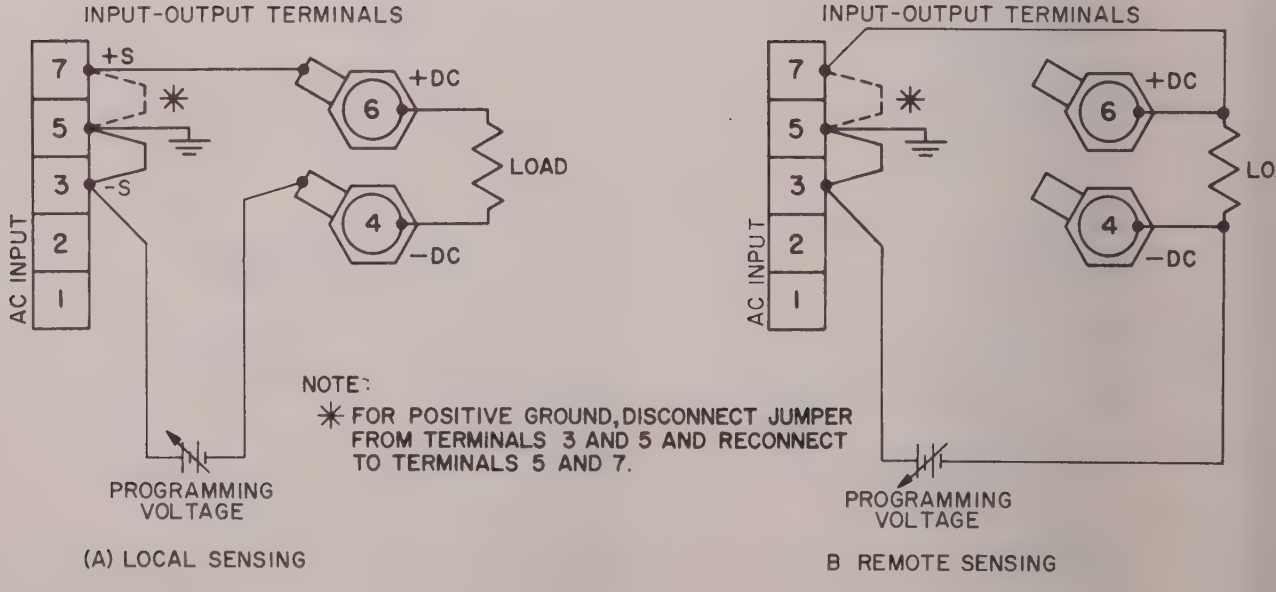


Figure 6. Programmed Voltage With External Programming Voltage Source

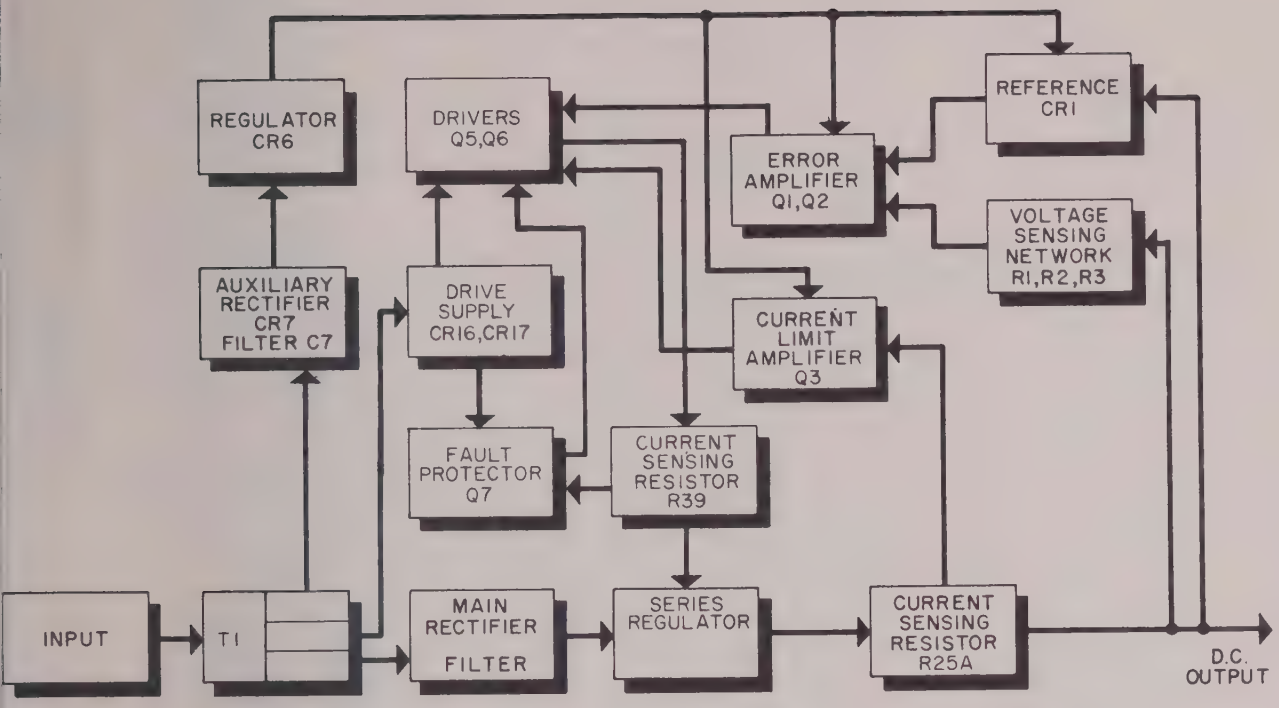
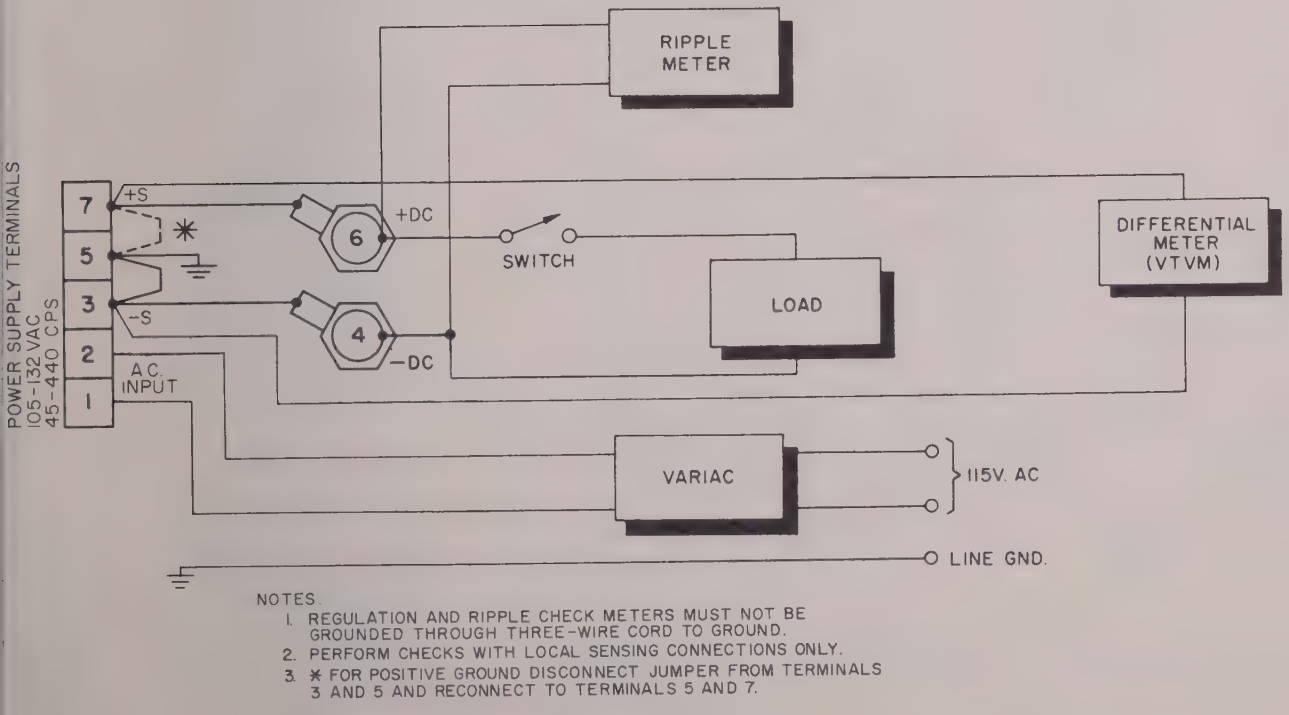


Figure 7. Typical Block Diagram

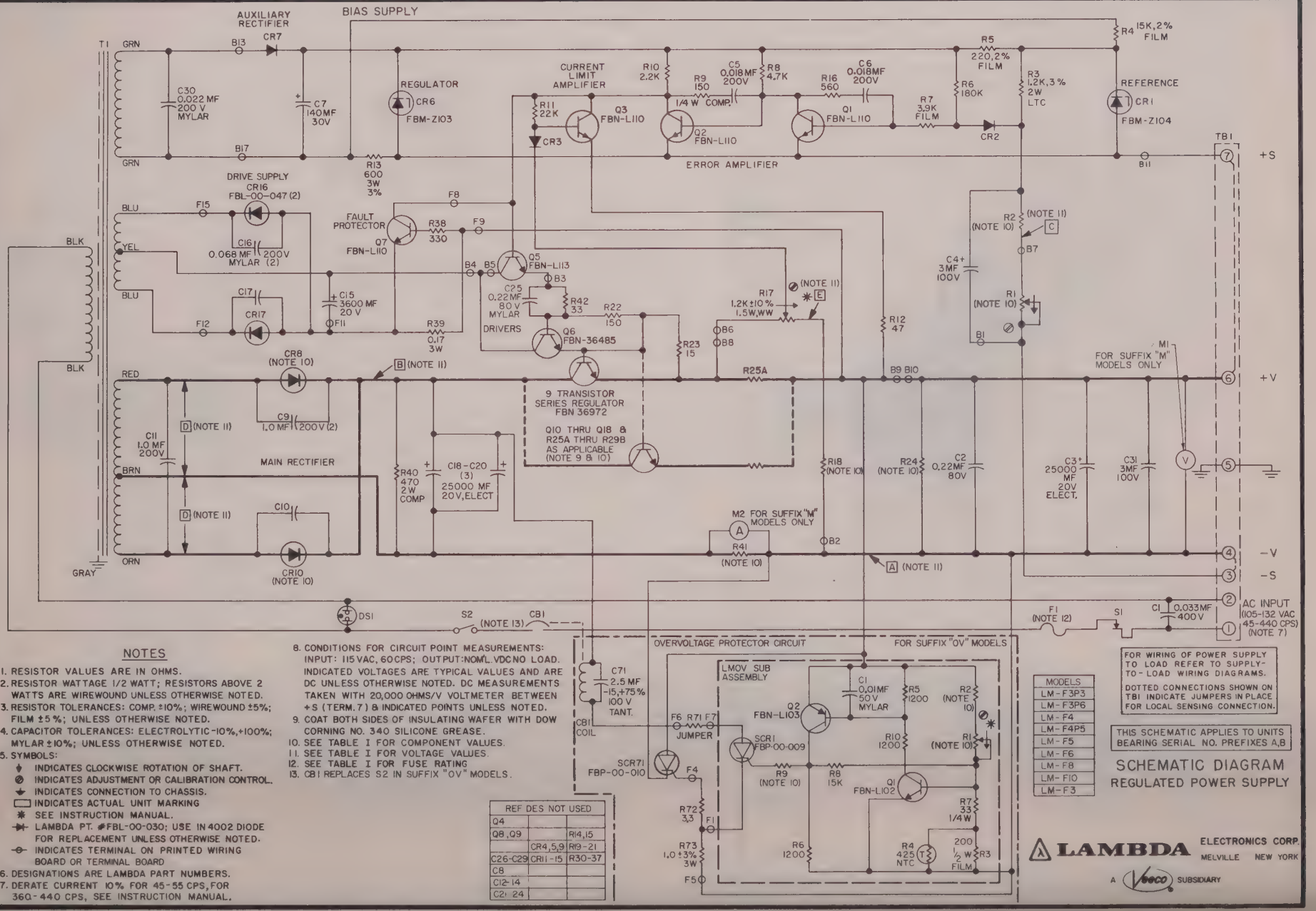


NOTES.

1. REGULATION AND RIPPLE CHECK METERS MUST NOT BE GROUNDED THROUGH THREE-WIRE CORD TO GROUND.
2. PERFORM CHECKS WITH LOCAL SENSING CONNECTIONS ONLY.
3. * FOR POSITIVE GROUND DISCONNECT JUMPER FROM TERMINALS 3 AND 5 AND RECONNECT TO TERMINALS 5 AND 7.

Figure 8. Test Connections for Performance Checks

SCB-F3-10C



NOTES

1. RESISTOR VALUES ARE IN OHMS.
2. RESISTOR WATTAGE 1/2 WATT; RESISTORS ABOVE 2 WATTS ARE WIREWOUND UNLESS OTHERWISE NOTED.
3. RESISTOR TOLERANCES: COMP. ±10%; WIREWOUND ±5%; FILM ±5%; UNLESS OTHERWISE NOTED.
4. CAPACITOR TOLERANCES: ELECTROLYTIC -10%,+100%; MYLAR ±10%; UNLESS OTHERWISE NOTED.
5. SYMBOLS:
   - ♦ INDICATES CLOCKWISE ROTATION OF SHAFT.
   - ⊘ INDICATES ADJUSTMENT OR CALIBRATION CONTROL.
   - ⏚ INDICATES CONNECTION TO CHASSIS.
   - ▭ INDICATES ACTUAL UNIT MARKING
   - ✱ SEE INSTRUCTION MANUAL.
   - ⊣▷⊢ LAMBDA PT. #FBL-00-030; USE IN 4002 DIODE FOR REPLACEMENT UNLESS OTHERWISE NOTED.
   - ⊸ INDICATES TERMINAL ON PRINTED WIRING BOARD OR TERMINAL BOARD
6. DESIGNATIONS ARE LAMBDA PART NUMBERS.
7. DERATE CURRENT 10% FOR 45-55 CPS, FOR 360-440 CPS, SEE INSTRUCTION MANUAL.
8. CONDITIONS FOR CIRCUIT POINT MEASUREMENTS: INPUT: 115 VAC, 60 CPS; OUTPUT: NOM'L. VDC NO LOAD. INDICATED VOLTAGES ARE TYPICAL VALUES AND ARE DC UNLESS OTHERWISE NOTED. DC MEASUREMENTS TAKEN WITH 20,000 OHMS/V VOLTMETER BETWEEN +S (TERM. 7) & INDICATED POINTS UNLESS NOTED.
9. COAT BOTH SIDES OF INSULATING WAFER WITH DOW CORNING NO. 340 SILICONE GREASE.
10. SEE TABLE I FOR COMPONENT VALUES.
11. SEE TABLE I FOR VOLTAGE VALUES.
12. SEE TABLE I FOR FUSE RATING
13. CB1 REPLACES S2 IN SUFFIX "OV" MODELS.

REF DES NOT USED		
Q4		
Q8, Q9		R14, I5
	CR4, 5, 9	R19-21
C26-C29	CR11-15	R30-37
C8		
C12-14		
C21-24		

MODELS
LM-F3P3
LM-F3P6
LM-F4
LM-F4P5
LM-F5
LM-F6
LM-F8
LM-F10
LM-F3

FOR WIRING OF POWER SUPPLY TO LOAD REFER TO SUPPLY-TO-LOAD WIRING DIAGRAMS.

DOTTED CONNECTIONS SHOWN ON TB1 INDICATE JUMPERS IN PLACE FOR LOCAL SENSING CONNECTION.

THIS SCHEMATIC APPLIES TO UNITS BEARING SERIAL NO. PREFIXES A,B

SCHEMATIC DIAGRAM
REGULATED POWER SUPPLY

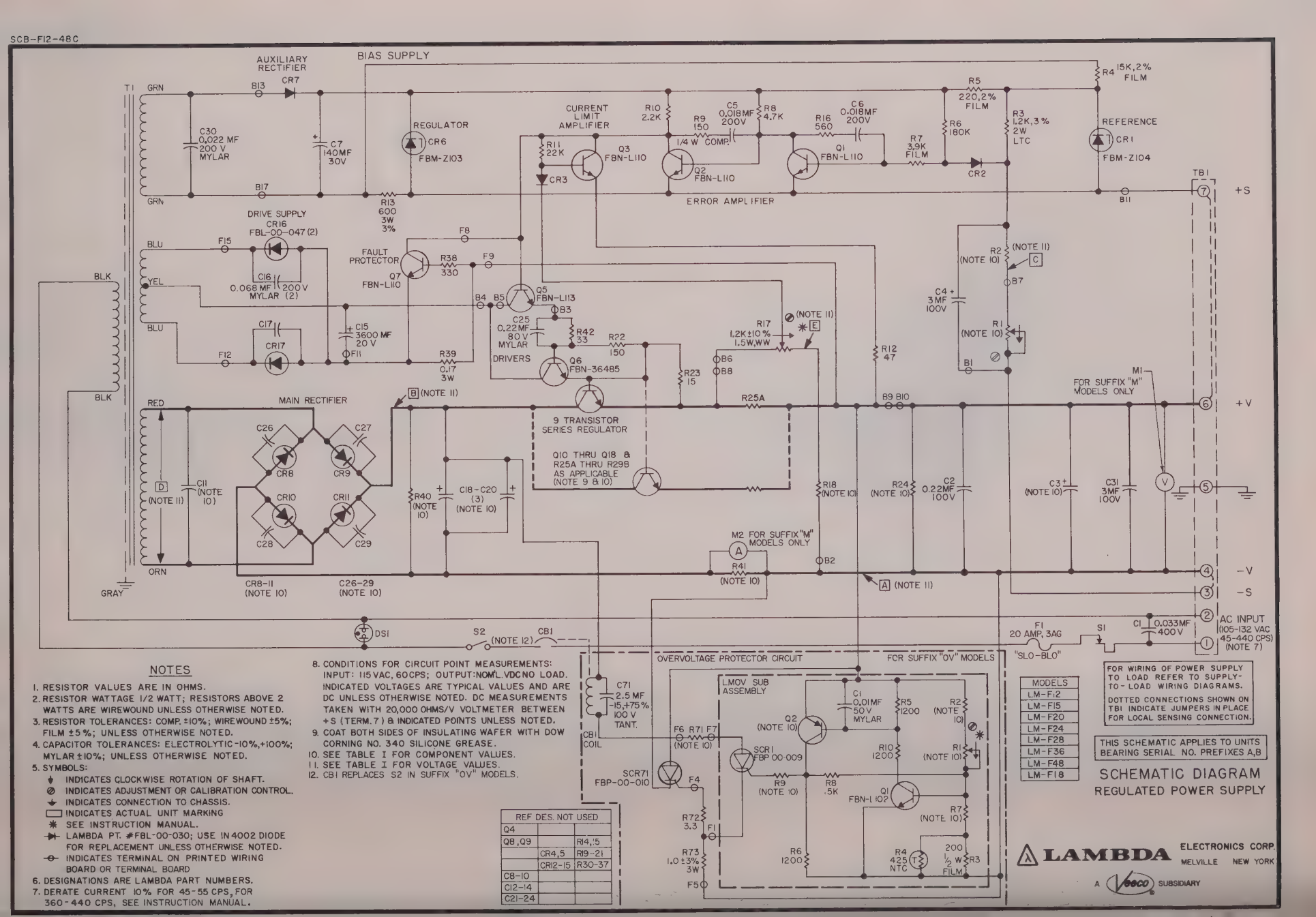
LAMBDA ELECTRONICS CORP.
MELVILLE NEW YORK
A Vaco SUBSIDIARY

TABLE I

DATA REFERENCES FOR MODELS LM-F3--LM-F10

Model	Voltage Range (VDC)	Max. Current (Amps)				Schematic Voltage Measurement					Schematic Components							LMOV Subassembly		
		40°C	50°C	60°C	71°C	A (VDC)	B (VDC)	C (VDC)	D (VAC)	E (VDC)	CR8, CR10 (FBL00-)	F1 (3AG)	R1 5%, 5W	R2 3%, 3W	R18 5%, 1/2W	R24 10%, 2W	R25A, B - R29A, B (Value/Section)	R1 10%, 1W	R2 1/2W	R9 10%, 1/2W
LM-F3	3±5%	48.0	42.0	34.0	25.0	-3.0	+9.0	-2.1	9.0	0.0	058	15A	300	430	Jumper	68	0.18±5%, 11W	2,000	560, 2%	22
LM-F3P3	3.3±5%	48.0	42.0	34.0	25.0	-3.3	+8.7	-2.1	9.0	0.0	058	15A	600	430	Jumper	68	0.18±5%, 11W	2,000	560, 2%	22
LM-F3P6	3.6±5%	48.0	42.0	34.0	25.0	-3.6	+8.4	-2.1	9.0	0.0	058	15A	600	430	Jumper	68	0.18±5%, 11W	2,000	560, 2%	22
LM-F4	4±5%	48.0	42.0	34.0	25.0	-4	+9.0	-3.0	9.7	0.0	058	15A	600	600	Jumper	68	0.18±5%, 11W	2,000	560, 2%	22
LM-F4P5	4.5±5%	48.0	42.0	34.0	25.0	-4.5	+8.5	-3.2	9.7	-3.4	058	15A	600	650	390	68	0.18±5%, 11W	2,000	560, 2%	22
LM-F5	5±5%	48.0	41.0	33.0	25.0	-5.0	+8.0	-3.2	9.7	-2.4	058	20A	600	650	1,300	68	0.18±5%, 11W	2,000	560, 2%	22
LM-F6	6±5%	47.0	40.0	32.0	24.0	-6.0	+9.0	-4.0	11.1	-2.9	058	20A	600	800	1,300	180	0.18±5%, 11W	2,000	560, 2%	22
LM-F8	8±5%	44.0	37.0	30.0	23.0	-8.0	+9.0	-6.0	12.5	-2.7	059	20A	1000	1200	2,400	180	0.18±5%, 11W	5,000	1470, 1%	68
LM-F10	10±5%	38.0	33.0	27.0	21.0	-10.0	+8.8	-6.0	13.8	-3.3	059	20A	2200	1200	2,400	180	0.30±5%, 11W	5,000	1470, 1%	68

SCB-F12-48C



NOTES

1. RESISTOR VALUES ARE IN OHMS.
2. RESISTOR WATTAGE 1/2 WATT; RESISTORS ABOVE 2 WATTS ARE WIREWOUND UNLESS OTHERWISE NOTED.
3. RESISTOR TOLERANCES: COMP. ±10%; WIREWOUND ±5%; FILM ±5%; UNLESS OTHERWISE NOTED.
4. CAPACITOR TOLERANCES: ELECTROLYTIC -10%,+100%; MYLAR ±10%; UNLESS OTHERWISE NOTED.
5. SYMBOLS:
   - INDICATES CLOCKWISE ROTATION OF SHAFT.
   - INDICATES ADJUSTMENT OR CALIBRATION CONTROL.
   - INDICATES CONNECTION TO CHASSIS.
   - INDICATES ACTUAL UNIT MARKING
   - SEE INSTRUCTION MANUAL.
   - LAMBDA PT. #FBL-00-030; USE IN4002 DIODE FOR REPLACEMENT UNLESS OTHERWISE NOTED.
   - INDICATES TERMINAL ON PRINTED WIRING BOARD OR TERMINAL BOARD
6. DESIGNATIONS ARE LAMBDA PART NUMBERS.
7. DERATE CURRENT 10% FOR 45-55 CPS, FOR 360-440 CPS, SEE INSTRUCTION MANUAL.
8. CONDITIONS FOR CIRCUIT POINT MEASUREMENTS: INPUT: 115 VAC, 60CPS; OUTPUT: NOML. VDC NO LOAD. INDICATED VOLTAGES ARE TYPICAL VALUES AND ARE DC UNLESS OTHERWISE NOTED. DC MEASUREMENTS TAKEN WITH 20,000 OHMS/V VOLTMETER BETWEEN +S (TERM. 7) & INDICATED POINTS UNLESS NOTED.
9. COAT BOTH SIDES OF INSULATING WAFER WITH DOW CORNING NO. 340 SILICONE GREASE.
10. SEE TABLE I FOR COMPONENT VALUES.
11. SEE TABLE I FOR VOLTAGE VALUES.
12. CB1 REPLACES S2 IN SUFFIX "OV" MODELS.

REF DES. NOT USED		
Q4		
Q8,Q9		R14,15
	CR4,5	R19-21
	CR12-15	R30-37
C8-10		
C12-14		
C21-24		

MODELS
LM-F12
LM-F15
LM-F20
LM-F24
LM-F28
LM-F36
LM-F48
LM-F18

FOR WIRING OF POWER SUPPLY TO LOAD REFER TO SUPPLY-TO-LOAD WIRING DIAGRAMS.

DOTTED CONNECTIONS SHOWN ON TB1 INDICATE JUMPERS IN PLACE FOR LOCAL SENSING CONNECTION.

THIS SCHEMATIC APPLIES TO UNITS BEARING SERIAL NO. PREFIXES A,B

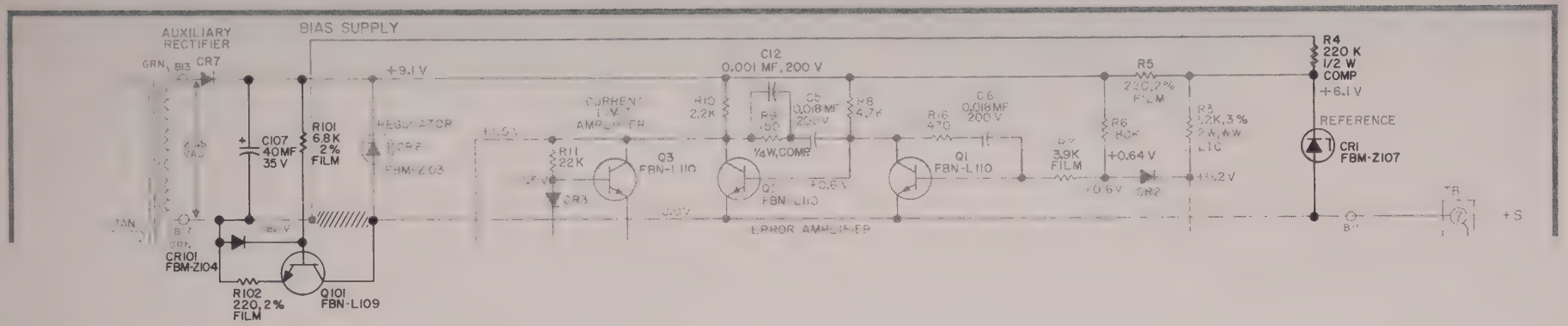
SCHEMATIC DIAGRAM
REGULATED POWER SUPPLY

LAMBDA ELECTRONICS CORP. MELVILLE NEW YORK
A Veeco SUBSIDIARY

TABLE 1

DATA REFERENCES FOR MODELS LM-F12--LM-F48

Model	Voltage Range (VDC)	Max. Current (Amps)				Schematic Voltage Measurement					Schematic Components																		
		40°C	50°C	60°C	71°C	A (VDC)	B (VDC)	C (VDC)	D (VAC)	E (VDC)	C9	C11	C18-C20	C26-C29	CR8-CR11 (FBLOO-)	Q10-Q18 (FBN-)	R1 5%, 5W	R2 3%, 2W	R18 5%, 1/2W	R24 10%, 2W	R25A, B - R29A, B (Value/Section)	R40 10%, 2W	R41 Meter Shunt	R71	LMOV Subassembly				
																									Q2 (FBN-)	R1 10%, 1W	R2	R7 5%, 1/4W	R9 10%, 1/2W
LM-F12	12±5%	33.0	28.0	22.0	17.0	-12.0	+12.0	-9.0	18.0	-4.0	14000MF, 35V 60V SURGE	1.0MF ±20% 200V	14000MF, 35V 60V SURGE	1.0MF±20% 200V	058	36972	2200	1800	2400	180	0.30±5%, 11W	1000	30A	2.0±3% 3W	L103	5000	1470±1% 1/2W	33	68
LM-F15	15±5%	28.0	24.0	19.0	16.0	-15.0	+13.0	-9.0	20.8	-5.0	14000MF, 35V 60V SURGE	1.0MF ±20% 200V	14000MF, 35V 60V SURGE	1.0MF±20% 200V	058	36485	2200	1800	2400	470	0.47±5%, 8W	1000	30A	2.0±3% 3W	L103	5000	1470±1% 1/2W	33	68
LM-F18	18±5%	25.0	22.0	18.0	14.0	-18.0	+12.8	-12.5	22.8	-2.7	14000MF, 35V 60V SURGE	1.0MF ±20% 200V	14000MF, 35V 60V SURGE	1.0MF±20% 200V	058	36485	2200	2500	6800	470	0.47±5%, 8W	1000	30A	2.0±3% 3W	L114	20,000	4700±2% 1/2W	39	220
LM-F20	20±5%	23.0	20.0	17.0	13.0	-20.0	+13.8	-12.5	24.9	-3.0	14000MF, 35V 60V SURGE	1.0MF ±20% 200V	14000MF, 35V 60V SURGE	1.0MF±20% 200V	056	36220	2200	2500	6800	470	0.47±5%, 8W	1000	30A	2.0±3% 3W	L114	20,000	4700±2% 1/2W	39	220
LM-F24	24±5%	20.0	17.0	14.0	11.0	-24.0	+17.7	-18.0	30.5	-3.6	7800MF, 60V 100V SURGE	1.0MF±20% 200V	7800MF, 60V 100V SURGE	1.0MF±20% 200V	056	36220	2200	3600	6800	1000	0.75±5%, 8W	5600	Not Used	2.0±3% 3W	L114	20,000	4700±2% 1/2W	39	220
LM-F28	28±5%	19.0	16.0	13.0	10.0	-28.0	+17.6	-22.5	33.2	-4.2	7800MF, 60V 100V SURGE	1.0MF ±20% 200V	7800MF, 60V 100V SURGE	1.0MF±20% 200V	056	36220	2200	4500	6800	1000	0.75±5%, 8W	5600	Not Used	5.0±5% 5W	L114	20,000	4700±2% 1/2W	39	220
LM-F36	36±5%	13.0	11.0	10.0	7.5	-36.0	+19.5	-28.0	40.2	-3.9	7800MF, 60V 100V SURGE	0.15MF ±20% 400V	7800MF, 60V 100V SURGE	0.15MF±20% 400V	056	36487	3300	5600	10,000	1000	0.75±5%, 8W	5600	Not Used	5.0±5% 5W	L114	20,000	4700±2% 1/2W	39	220
LM-F48	48±5%	10.0	9.0	7.5	6.0	-48.0	+27.0	-40.0	54.0	-5.2	3000MF, 100V 150V SURGE	0.15MF ±20% 400V	3000MF, 100V 150V SURGE	0.15MF ±20% 400V	057	36487	3300	8000	10,000	1500	1.5±5%, 8W	5600	Not Used	10.0±5% 5W	L114	20,000	4700±2% 1/2W	39	220



NOTES:
1. "Y" OPTION COMPONENTS ARE SHOWN IN SOLID BLACK LINE.
2. REFER TO POWER SUPPLY SCHEMATIC DIAGRAM IN THIS MANUAL FOR ALL OTHER COMPONENTS LOCATED ON THE UNIT.
3. FOR "Y" OPTION SCHEMATIC R4 CHANGES VALUE, C7 BECOMES C107 AND CHANGES VALUE; R13 IS DELETED; R101, CR101, R102, Q101 ARE ADDED; CR1 PART NO. CHANGES.

TYPICAL "Y" OPTION SCHEMATIC DIAGRAM

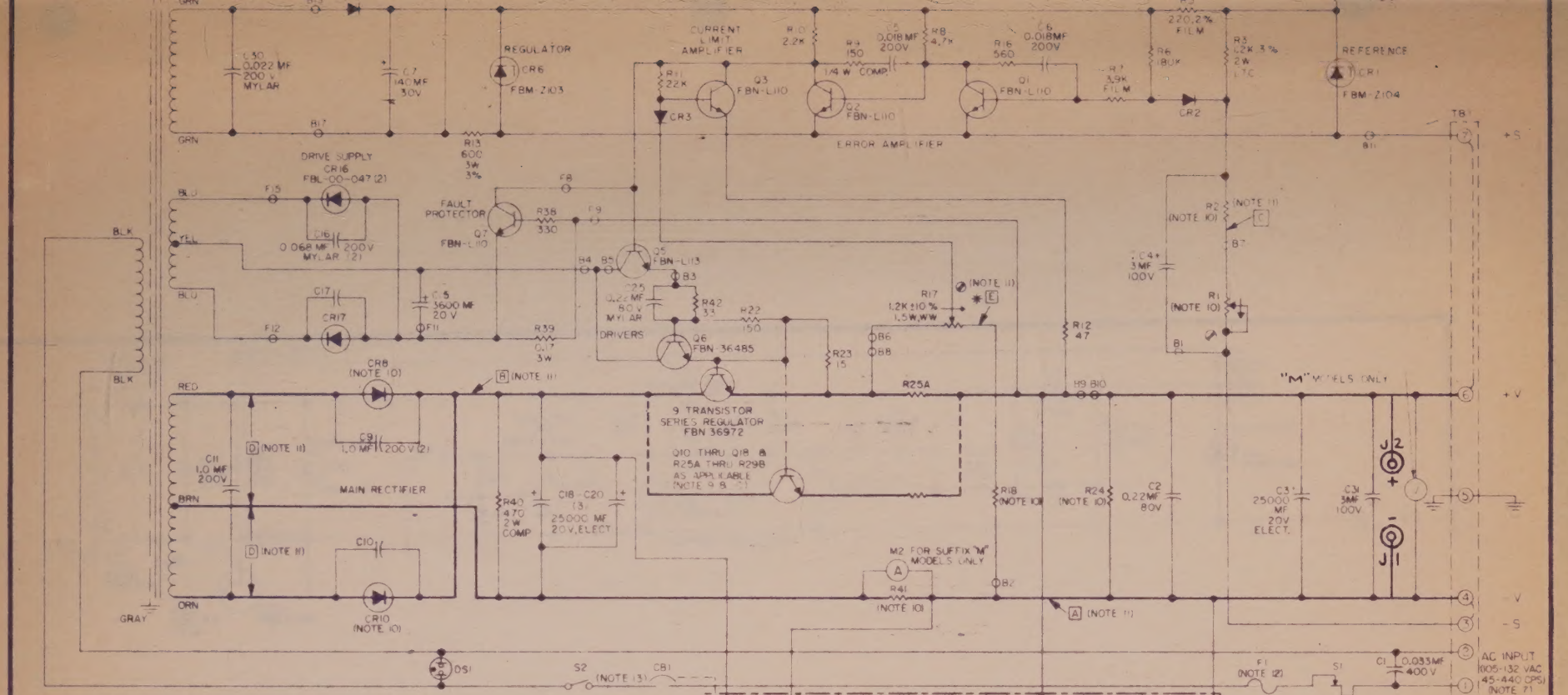
LAMBDA
ELECTRONICS CORP.
MELVILLE NEW YORK

TABLE I

DATA REFERENCES FOR MODELS LM F3--LM-F10

LMF4-0VY-2361

Model	V Range Range VDC	Max. Current (Amps) 45°C	50°C	60°C	71°C	Schematic Voltage Measurement A (VDC)	B (VDC)	C (VDC)	D (VAC)	E (VDC)	Schematic Components CR8, CR10 (FB1,00-)	F1 (3AG)	R1 5%, 5W	R2 3%, 3W	R18 5%, 1 2W	R24 10%, 2W	R25A, B - R29A, B (Value Section)	LMOV Subassembly R1 10%, 1W	R2 1 2W	R9 10%, 1 2W
LM-F3	3[illegible]	48.0	42.0	34.0	25.0	-3.0	+9.0	-2.1	9.0	0.0	058	15A	300	430	Jumper	68	0.18±5%, 11W	2,000	560, 2%	22
LM-F4	3.6[illegible]	48.0	42.0	34.0	25.0	-3.3	+8.7	-2.1	9.0	0.0	058	15A	600	430	Jumper	68	0.18±5%, 11W	2,000	560, 2%	22
LM-F5	3.6[illegible]	48.0	42.0	34.0	25.0	-3.6	+8.4	-2.1	9.0	0.0	058	15A	600	430	Jumper	68	0.18±5%, 11W	2,000	560, 2%	22
LM-F4 0VY-2361	4[illegible]	48.0	42.0	34.0	25.0	-4	+9.0	-3.0	9.7	0.0	058	15A	600	600	Jumper	68	0.18±5%, 11W	2,000	560, 2%	22
LM-F4P5	4[illegible]	48	42.0	34.0	25.0	-4.5	+8.5	-3.2	9.7	-3.4	058	15A	600	650	390	68	0.18±5%, 11W	2,000	560, 2%	22
LM-F7	6[illegible]	46.0	41.0	33.0	25.0	-5.0	+8.0	-3.2	9.7	-2.4	058	20A	600	650	1,300	68	0.18±5%, 11W	2,000	560, 2%	22
LM-F8	6[illegible]5%	47.0	40.0	32.0	24.0	-6.0	+9.0	-4.0	11.1	-2.9	058	20A	600	800	1,300	180	0.18±5%, 11W	2,000	560, 2%	22
LM-F9	[illegible]	44.0	37.0	30.0	23.0	-8.0	+9.0	-6.0	12.5	-2.7	059	20A	1000	1200	2,400	180	0.18±5%, 11W	5,000	1470, 1%	68
LM-F10	1[illegible]	38.0	33.0	27.0	21.0	-10.0	+8.8	-6.0	13.8	-3.3	059	20A	2200	1200	2,400	180	0.30±5%, 11W	5,000	1470, 1%	68



NOTES

1. RESISTOR VALUES ARE IN OHMS.
2. RESISTOR WATTAGE 1/2 WATT, RESISTORS ABOVE 2 WATTS ARE WIREWOUND UNLESS OTHERWISE NOTED.
3. RESISTOR TOLERANCES: COMP ±10%; WIREWOUND ±5%; FILM ±5%; UNLESS OTHERWISE NOTED.
4. CAPACITOR TOLERANCES: ELECTROLYTIC -10%, +100%; MYLAR ±10%; UNLESS OTHERWISE NOTED.
5. SYMBOLS:
   - ♦ INDICATES CLOCKWISE ROTATION OF SHAFT.
   - ⊘ INDICATES ADJUSTMENT OR CALIBRATION CONTROL.
   - ⏚ INDICATES CONNECTION TO CHASSIS.
   - ▭ INDICATES ACTUAL UNIT MARKING.
   - ✱ SEE INSTRUCTION MANUAL.
   - ⊣⊢ LAMBDA PT. #FBL-00-030; USE IN4002 DIODE FOR REPLACEMENT UNLESS OTHERWISE NOTED.
   - ⊖ INDICATES TERMINAL ON PRINTED WIRING BOARD OR TERMINAL BOARD.
6. DESIGNATIONS ARE LAMBDA PART NUMBERS.
7. DERATE CURRENT 10% FOR 45-55 CPS, FOR 360-440 CPS, SEE INSTRUCTION MANUAL.
8. CONDITIONS FOR CIRCUIT POINT MEASUREMENTS: INPUT: 115 VAC, 60 CPS; OUTPUT: NOML VDC NO LOAD. INDICATED VOLTAGES ARE TYPICAL VALUES AND ARE DC UNLESS OTHERWISE NOTED. DC MEASUREMENTS TAKEN WITH 20,000 OHMS/V VOLTMETER BETWEEN +S (TERM 7) & INDICATED POINTS UNLESS NOTED.
9. COAT BOTH SIDES OF INSULATING WAFER WITH DOW CORNING NO. 340 SILICONE GREASE.
10. SEE TABLE-I FOR COMPONENT VALUES.
11. SEE TABLE I FOR VOLTAGE VALUES.
12. SEE TABLE I FOR FUSE RATING.
13. CB1 REPLACES S2 IN SUFFIX "OV" MODELS.

REF DES NOT USED		
Q4		
Q8, Q9		R4, 15
	CR4, 5, 9	R19-21
C26-C29	CR11-15	R30-37
C8		
C12-14		
C21-24		

FOR WIRING OF POWER SUPPLY TO LOAD REFER TO SUPPLY TO-LOAD WIRING DIAGRAMS.

DOTTED CONNECTIONS SHOWN ON TB1 INDICATE JUMPERS IN PLACE FOR LOCAL SENSING CONNECTION.

THIS SCHEMATIC APPLIES TO UNITS BEARING SERIAL NO. PREFIXES 4,8

SCHEMATIC DIAGRAM
REGULATED POWER SUPPLY
LM F4-0VY-2361

LAMBDA ELECTRONICS CORP. MELVILLE NEW YORK
A Vesco SUBSIDIARY

5-Year Guarantee

We warrant each instrument manufactured by us, and sold by us or our authorized agents, to be free from defects in material and workmanship, and that it will perform within applicable specifications for a period of five years after original shipment. Our obligation under this guarantee is limited to repairing or replacing any instrument or part thereof, (except tubes and fuses) which shall, within five years after delivery to the original purchaser, be returned to us with transportation charges prepaid, prove after our examination to be thus defective.

We reserve the right to discontinue instruments without notice, and to make modifications in design at any time without incurring any obligation to make such modifications to instruments previously sold.

LAMBDA ELECTRONICS CORP.
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MA28779